

# 12.2 Nuclear Physics

## Question Paper

Course	DPIB Physics
Section	12. Quantum & Nuclear Physics (HL only)
Topic	12.2 Nuclear Physics
Difficulty	Easy

**Time allowed:** 20  
**Score:** /10  
**Percentage:** /100

### Question 1

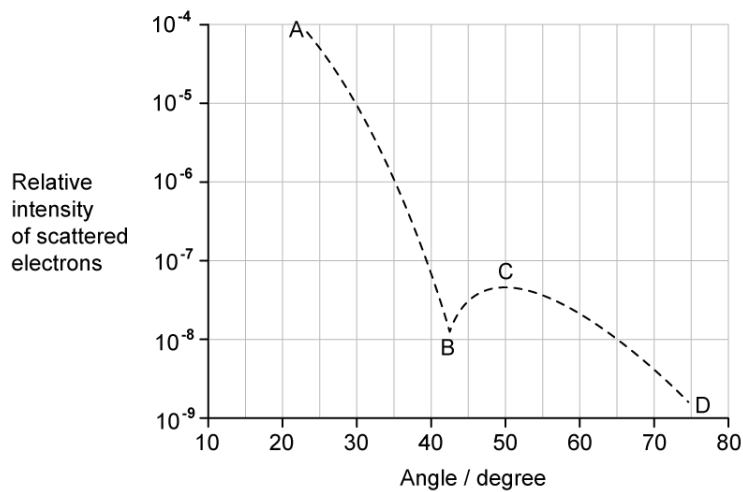
Which of the following statements about the nuclear radius is incorrect?

- A. As more nucleons are added to a nucleus the radius increases
- B. The radius of nuclei depends on the atomic number,  $Z$  of the nucleus
- C. The exact relationship between the radius and nucleon number can be determined from experimental data
- D. The radius of the nucleus can be calculated using an equation which involves the constant of proportionality,  $R_0$

[1 mark]

### Question 2

The graph shows the scattering of electrons due to diffraction by oxygen-16 nuclei.



Which point on the graph represents the first minimum?

[1 mark]

### Question 3

What do the deviations from the Rutherford scattering give evidence for?

- A. The nuclear radius
- B. The charge on the nucleus
- C. The electrostatic force
- D. The strong nuclear force

[1 mark]

### Question 4

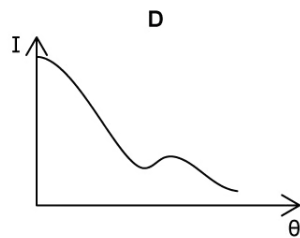
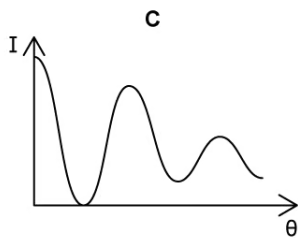
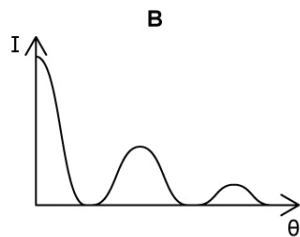
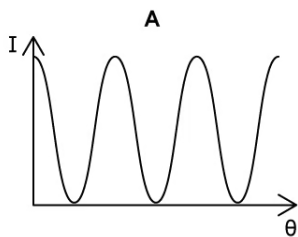
What is the radius of cobalt-27?

- A. 3.6 fm
- B. 10.8 fm
- C. 27 fm
- D. 32.4 fm

[1 mark]

### Question 5

Which graph shows how intensity  $I$  varies with angle  $\theta$  when electrons are diffracted by a nucleus?



[1 mark]

### Question 6

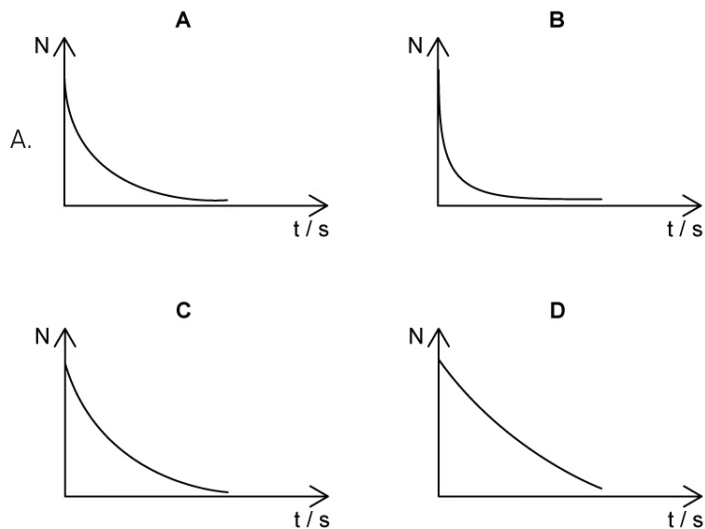
Which of the following is the unit for the decay constant  $\lambda$ ?

- A.  $\text{Bq s}^{-1}$
- B. s
- C.  $\text{s}^{-1}$
- D. The decay constant has no units

[1 mark]

### Question 7

Which of the following graphs of the number of undecayed nuclei  $N$  over time has the smallest decay constant?



**Question 8**

[1 mark]

Which of the following provides evidence for the existence of neutrinos?

- A. Some particles were indistinguishable from their antiparticles
- B. Nuclear energy levels have a continuous spectrum
- C. The energy of emitted beta particles have a continuous spectrum
- D. The emission spectrum only contains specific wavelengths

[1 mark]

**Question 9**

When alpha particles of speed  $v$  are directed at nuclei with atomic number  $A$ , scattering occurs. Small deviations from the predicted intensity of the scattered particles are observed.

Which change in nucleon number and energy will give the greatest deviation from the Rutherford scattering predictions?

	Atomic number	Speed
A.	decrease	increase
B.	decrease	decrease
C.	increase	increase
D.	increase	decrease

[1 mark]

**Question 10**

A radioactive element has a decay constant  $\lambda$ . At time,  $t = 0$  the number of nuclei of this element is  $N_0$ . These are linked by the equation  $N_t = N_0 e^{-\lambda t}$  where  $N_t$  is the number of nuclei expected at time  $t$ .

What number of nuclei would you expect to remain after 1 second?

- A. 0
- B.  $N_0(1 - e^{-\lambda})$
- C.  $N_0 e^{-\lambda}$
- D. 1

[1 mark]



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